Attorney Docket No. PPW06-556DS

IN THE UNITED STATES PATENT & TRADEMARK OFFICE
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

IN RE APPLICATION OF:

Kang-Hyun LEE

SERIAL NO: **10/728,706**

FILED: **December 5, 2003**

FOR: **METHOD FOR FABRICATING METAL LINE OF SEMICONDUCTOR DEVICE**

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§ GROUP ART UNIT: **2813**
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§ EXAMINER: **Tuan H. NGUYEN**
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By: Jennie Heaton
Jennie Heaton

APPEAL BRIEF

SIR:

Appellants submit this Appeal Brief to the Board of Patent Appeals and Interferences to support the Appeal filed on July 31, 2006 in the above-referenced patent application.

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1. REAL PARTY IN INTEREST

The real party in interest is Dongbu Electronics Co., Ltd.

2. RELATED APPEALS AND INTERFERENCES

No other appeals or interferences are known to the Appellants, the Appellants' legal representative, or assignee which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal. However, a similar issue is raised in an appeal in Application No. 11/024,594 (Attorney Docket No. OPP-GZ-2004-0009-US-00), in which the claims have been rejected in view of Appellant's own disclosure, but Appellant has made no admission that any part of Appellant's own disclosure is or constitutes prior art.

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3. STATUS OF CLAIMS

Claims 1-18 and 20-22 are pending in the application. Claims 1-18 and 20-22 stand rejected in view of Appellant's disclosure in the present application and two citable references as discussed below. The rejections of Claims 1-18 and 20-22 in view of Appellant's disclosure and the cited references are appealed. The pending Claims are shown in the attached Appendix.

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4. STATUS OF AMENDMENTS

A response was filed on May 31, 2006 in response to a final Office Action dated March 31, 2006. No amendments were made or entered in the response.

An Advisory Action was mailed on June 23, 2006. The Advisory Action reiterated the Examiner's rejections of the Appellants' Claims enumerated in the Final Office Action.

A Notice of Appeal and a Pre-Appeal Brief Request for Review were filed on July 31, 2006. The Notice of Panel Decision dated August 29, 2006 indicated that the application remains under appeal. The Claims on appeal are those that were rejected in the final Office Action dated March 31, 2006.

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5. SUMMARY OF CLAIMED SUBJECT MATTER

The present invention relates to a method for fabricating a metal line of a semiconductor device. The method generally forms a photoresist pattern on a metal layer, where the photoresist has a thickness of less than 9000 Å; forming a buffer layer on the photoresist pattern, including in an opening in the photoresist pattern; and removing the metal layer at a lower side of the opening by dry etching to form a plurality of metal lines. In one aspect, the photoresist pattern has an opening of less than or equal to 0.26 μm width (as recited in Claim 1), and in a related aspect, a ratio of the photoresist thickness to the width of the opening is less than about 3.5 (as recited in Claim 22).

The method shows unexpected improvements in defect reduction relative to otherwise identical methods in which no buffer layer is formed on the photoresist pattern and either:

(i) The photoresist has a thickness greater than 9000 Å and a ratio of the photoresist thickness to the width of the opening is greater than about 3.5; or

(ii) The photoresist has a thickness less than 9000 Å (see, e.g., paragraph 4 of the Declaration of Kang-Hyun Lee filed January 12, 2006; hereinafter, the "Lee Declaration").

As required by 37 C.F.R. § 41.37(c)(1)(v), Appellant's representative explains below the subject matter defined in each of the independent claims involved in the appeal, referring to the specification by page and line number, and to the drawings by reference characters. It should be

understood, however, that the appealed Claims may read on other portions of the specification or other figures that are not listed below.

Independent Claim 1

Claim 1 positively recites (with page and line numbers from the specification added in compliance with 37 C.F.R. 41.37(c)(1)(v), and for reference purposes only):

1. A method for fabricating a metal line of a semiconductor device, comprising the steps of:
   a) forming an insulation layer on a semiconductor substrate on which devices or lower lines are formed (p. 3, ll. 7-8);
   b) forming a metal layer on the insulation layer (p. 3, ll. 8-10);
   c) forming a photoresist pattern having an opening of less than or equal to 0.26 μm width on the metal layer (p. 3, ll. 13-20 and 28-31), wherein the photoresist has a thickness of less than 9000 Å (p. 3, ll. 28-31);
   d) forming a buffer layer on the photoresist pattern, including in the opening (p. 4, ll. 3-4 and 14-17); and
   e) selectively removing the metal layer at a lower side of the opening by dry etching to form a plurality of metal lines such that a dimension between adjacent metal lines is less than the width of said opening (p. 4, ll. 9-22, and Claim 1, ll. 8-9 as originally filed).

Independent Claim 22

Claim 22 positively recites (with page and line numbers from the specification added in compliance with 37 C.F.R. 41.37(c)(1)(v), and for reference purposes only):

22. A method for fabricating a metal line of a semiconductor device, comprising the steps of:

a) forming an insulation layer on a semiconductor substrate on which devices or lower lines are formed (p. 3, ll. 7-8);

b) forming a metal layer on the insulation layer (p. 3, ll. 8-10);

c) forming a photoresist pattern having an opening of a certain width on the metal layer (p. 3, ll. 13-20), wherein said photoresist has a thickness of less than 9000 Å and a ratio of said photoresist thickness to said certain width of said opening is less than about 3.5 (p. 3, ll. 28-31);

d) forming a buffer layer on the photoresist pattern, including in the opening (p. 4, ll. 3-4 and 14-17); and

e) selectively removing the metal layer at a lower side of the opening by dry etching to form a plurality of metal lines such that a dimension between adjacent metal lines is less than the width of said opening (p. 4, ll. 9-22, and Claim 1, ll. 8-9 as originally filed).

With respect to FIGS. 2-3 of Appellants' application, in one embodiment, an insulation layer 12 is formed on a semiconductor substrate on which devices or lower lines and the like are formed, and a lower metal layer 14a, an intermediate metal layer 14b and an upper metal layer 14c are layered in order above the insulation layer 12. A photoresist pattern 18 is then provided on an organic anti-reflection coating 16 by applying a photoresist film thereon, exposing the photoresist film using a photomask, and developing the exposed photoresist film. The photoresist pattern 18 has an opening 18' of certain width W, which is an important factor for determining a critical dimension (CD) of the metal line 14.

In this embodiment, when forming a metal line 18 having a critical dimension (CD) of less than 0.23 μm, the opening of the photoresist pattern 18 can be formed at a width W of 0.26 μm or more, and the photoresist pattern 18 can have a thickness T of less than 9,000 Å. After the

photoresist pattern 18 having an opening 18' of width W is formed, a buffer layer 20 is formed on the pattern 18 as shown in Fig. 2. Subsequently, when dry etching is performed, the buffer layer 20, the organic anti-reflection coating 16, the upper metal layer 14c, the intermediate layer 14b and the lower metal layer 14a under the opening W are etched in order until a top surface of the insulation layer 12 is exposed, as shown in Fig. 3. Thus, the critical dimension (CD) of the metal line 14 (i.e., the etching width of the upper, intermediate and lower metal layers 14c, 14b and 14a) is set in association with the thickness of the buffer layer 20 provided at an inner side wall of the opening W. Namely, in this example, the critical dimension (CD) is the result of subtracting twice the thickness T1 of the buffer layer from the width W of the opening 18' {i.e., CD = W - (2 x T1)}. Accordingly, even when the width W of the opening of the photoresist pattern 18 is 0.26 μm, the metal line 14 can be formed at a critical dimension (CD) of 0.23 μm or less due to the buffer layer 20 formed at the inner side wall of the opening 18'.

When the metal line is formed according to the above-described process, the critical dimension of the metal line can have the same dimension as the prior art while decreasing the thickness of the photoresist pattern and increasing the width of the opening of the photoresist pattern. Accordingly, characteristics of devices can be improved by significantly improving the margin in photo processing, and device yields can be improved (e.g., by reducing an incidence of a metal bridge phenomenon).

Furthermore, the claimed method above reduces the likelihood of "metal stringer" (or other short circuit-causing) defects and any adverse effects from dry etch damage to an upper surface of metal lines to levels or values that are acceptable for commercial semiconductor manufacturing processes (see, e.g., paragraph 14 of the Lee Declaration). One of ordinary skill

in the art of semiconductor manufacturing would not understand or appreciate from reading the patents cited against the present claims 1 and 22 that the claimed method would provide the observed improvements in defect reduction (i.e., ***from commercially unacceptable levels to commercially acceptable levels***; see paragraph 15 of the Lee Declaration; emphasis added).

6. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. The rejection of Claims 1, 3, 4, 18, and 20-22 under 35 U.S.C. § 103(a) as being unpatentable over the Background as described in the present application in view of U.S. Patent No. 6,750,150 to Chung et al.

2. The rejection of Claims 2 and 5-17 under 35 U.S.C. § 103(a) as being unpatentable over the Background as described in the present application in view of U.S. Patent No. 6,750,150 to Chung et al. and U.S. Patent No. 6,383,942 to Narita et al.

REFERENCES

The following references are relied on by the Examiner:

1) Appellant's application.

2) U.S. Patent No. 6,750,150 to Chung et al. (hereinafter, "Chung").

3) U.S. Patent No. 6,383,942 to Narita et al. (hereinafter, "Narita").

Brief Description of the References

1) In the Background section of the present application, Appellant discloses a conventional general metal line fabrication method. First, an insulation layer is formed by depositing an oxide film on a semiconductor substrate on which devices or lower lines and the like are formed, and then an aluminum metal layer is formed on the insulation layer. Subsequently, a photoresist pattern having openings of certain width is formed on the aluminum

metal layer, a partial region of the aluminum metal layer is removed by dry etching using the photoresist pattern as a mask, and then the photoresist pattern is removed to form an aluminum metal line. However, the biggest problem for fabricating the metal line using the photoresist pattern is that the dry etching process has a bad selectivity with the photoresist. Therefore, conventionally, the photoresist has a thickness of more than about 9,000Å when a metal line having a critical dimension (CD) of less than 0.23 μm is to be formed. However, a problem arises in that a random metal bridge phenomenon may occur as the photoresist pattern becomes thicker. To the contrary, when the photoresist pattern becomes thinner to increase the photo margin, a notching phenomenon may occur due to insufficient photoresist.

2) Chung relates to a semiconductor manufacturing method that includes defining a substrate, depositing a polysilicon layer over the substrate, depositing a layer of photoresist over the polysilicon layer, patterning and defining the photoresist layer, depositing a layer of inorganic material over the patterned and defined photoresist layer where the layer of inorganic material is conformal and photo-insensitive, and anisotropically etching the layer of inorganic material and the layer of semiconductor material (Abstract). Chung seeks to enhance the etching resistance of a patterned photoresist layer (col. 1, ll. 37-39), but appears to be silent with regard to any defect reduction effects of reducing the likelihood of "metal stringer" (or other short circuit-causing) defects.

3) Narita discloses a dry etching method for use in patterning stacked metal films containing aluminum as the base component and a thin film including at least one of titanium and titanium nitride. In this method, the thin film is dry-etched using a first etching gas composition for preventing the metal film from being processed. The metal film is then dry-

etched using a second etching gas composition other than the first etching gas (Abstract). The method of Narita intends to provide a dry etching method capable of patterning a stacked film such that the thin film is formed vertically and the metal film is prevented from being side-etched (col. 2, ll. 47-53) and/or reduce a pattern transfer difference in a stacked film (col. 3, ll. 1-4). As the Examiner correctly recognizes, Narita does not disclose forming a buffer layer as claimed.

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7. ARGUMENT

With respect to the first ground of rejection (i.e., of Claims 1, 3, 4, 18, and 20-22 under 35 U.S.C. § 103(a) as being unpatentable over the Background as described in the present application in view of Chung), Appellants group the claims as follows:

Group I : Claims 20 and 22;

Group II : Claims 1, 18 and 21;

Group III : Claim 3; and

Group IV : Claim 4.

With respect to the second ground of rejection (i.e., of Claims 2 and 5-17 under 35 U.S.C. § 103(a) as being unpatentable over the Background as described in the present application in view of Chung and Narita), Appellants group the claims together.

I. THE REJECTION OF CLAIMS 1, 3, 4, 18 AND 20-22 UNDER 35 U.S.C. § 103(a)

The Examiner reversibly erred in rejecting Claims 1, 3, 4, 18, and 20-22, because:

- The Examiner has assumed that Appellant's "Description of the Related Art" from the present application contains an admission that such information contained in such Description is or constitutes an admission of prior art when no such admission exists;
- The cited reference(s) fail to teach, show, or suggest a method including forming (on a metal layer) a photoresist pattern ***having a thickness of less than 9000Å*** and either an opening of less than or equal to 0.26 μm width (Claim 1) or an aspect

ratio (i.e., a ratio of the photoresist thickness to the width of the opening) of less than about 3.5 (Claim 22), forming a buffer layer on the photoresist pattern, and removing the metal layer at a lower side of the opening by dry etching to form a plurality of metal lines; and

- The Examiner has failed to explain where the prior art suggests the unexpected improvements of statistical and practical significance provided by the present invention (see the Declaration of Kang-Hyun Lee filed on January 12, 2006, and the Advisory Action dated June 23, 2006). For example, the present method produces unexpected improvements in defect reduction (e.g., from a process with ***commercially unacceptable levels to*** [a process with] ***commercially acceptable levels***; see paragraphs 15 and 22 of the Lee Declaration; emphasis added). Thus, even if one finds that all of the limitations of the present claims are suggested by the cited references, the cited references do not suggest such an improvement.

First and foremost, neither Appellant nor Appellant's representatives have, at any time, stated, indicated, admitted, or otherwise suggested that Appellant's Background constitutes prior art that is available against the present claims under any section of 35 U.S.C. § 102 et seq. Such use of Appellant's disclosure against him in prosecution discourages full and complete disclosure of all relevant information to the U.S. Patent and Trademark Office (USPTO), thus appearing to violate the USPTO's regulations and long-standing policy encouraging such disclosure (see, e.g., 37 C.F.R. §§ 1.56, 1.98 and 1.99, M.P.E.P. §§ 609 and 706.02(c), and particularly M.P.E.P. § 2129, which appears to require a statement "identifying the work of another as 'prior art'" in

order to constitute an admission that the work is available as prior art against the claims[6]). There is no such statement in either Appellant's Background or anywhere else in the present application, and there has been no such admission during prosecution.

If such information is actually prior art available against the pending claims, then a reference or other publication available under 35 U.S.C. § 102 and disclosing the same should have been located and properly cited. Alternatively, the Examiner could have taken official notice that Appellant's Background is commonly known in the art (or, perhaps, that some evidence unknown to Appellant's representative supports an assertion that Appellant has admitted that Appellant's Background is available as prior art) and relied on a self-executed Affidavit attesting to his personal knowledge of facts establishing such technology as prior art available under 35 U.S.C. § 102 against the claims:

> "If the examiner is relying on personal knowledge to support the finding of what is known in the art, the examiner must provide an affidavit or declaration setting forth specific factual statements and explanation to support the finding." M.P.E.P. § 2144.03, citing 37 C.F.R. 1.104(d)(2).

During prosecution, Appellant traversed any and all effective assertions of official notice that Appellant's Background is admitted prior art or are otherwise available as prior art (see p. 3 of the Amendment filed May 31, 2006). No subsequent communication from the U.S. Patent and Trademark Office provided any documentary evidence to maintain the rejection, so it is reversible error on the part of the Examiner to continue to maintain such a rejection in the absence of such documentary evidence. See M.P.E.P. § 2144.03; see also *In re Zurko*, 258 F.3d

[6] Mere inclusion in the background section of an application does not appear to be sufficient. Applicants' undersigned representative is not aware of any statutory, regulatory or policy basis for presuming or concluding that any disclosure in the background section of an application is an admission that such disclosure constitutes prior art available against the claims.

at 1386, 59 USPQ2d at 1697 ("[T]he Board [or examiner] must point to some concrete evidence in the record in support of these findings" to satisfy the substantial evidence test).

Instead, the Examiner has simply concluded that Appellant's Background must be admitted prior art because Appellant describes the technology as "conventional" (see the Continuation Sheet attached to the Advisory Action dated June 23, 2006). In his zeal to establish an admission, the Examiner asserts -- without factual support -- that "(t)his is a well-known process as admitted" (see the Continuation Sheet attached to the Advisory Action dated June 23, 2006), even though neither Appellant nor Appellant's representatives have made any admission that the process was known at all. Appellant has not identified the technology as the work of another. Consequently, it is possible that Appellant's Background describes an approach that Appellant took before arriving at the present invention. Alternatively, it could have been an approach that Appellant's coworkers took and kept secret before the present invention. There is simply no factual or legal basis for concluding that Appellant has admitted that Appellant's Background is prior art or constitutes prior art.

According to M.P.E.P. § 2129, part II, where the specification identifies work done by another as "prior art," the subject matter so identified is treated as admitted prior art. *In re Nomiya*, 509 F.2d 566, 571, 184 USPQ 607, 611 (CCPA 1975) (holding applicant's labeling of two figures in the application drawings as "prior art" to be an admission that what was pictured was prior art relative to applicant's improvement). However, the specification of the present application does not identify any material whatsoever as "prior art." In addition, any teaching or suggestion to make the claimed combination must **not be based on the applicant's disclosure**. *In re Vaeck*, 947 F.2d 488 (Fed. Cir. 1991). Therefore, it is believed to be reversible error to cite

the disclosure of the present application as a reference against itself to make an obviousness rejection.

Nonetheless, Appellant's Background discloses technology that is not part of the present invention and that Appellant does not intend to claim. The present invention represents an improvement over the subject matter disclosed in Appellant's Background.

Appellant's Background is discussed on pp. 12-13 above. Appellant's Background is saliently deficient with regard to forming a photoresist pattern having a thickness of less than 9000 Å; forming a buffer layer on the photoresist pattern, including in an opening therein; and selectively removing the metal layer at a lower side of the opening by dry etching to form metal lines such that a dimension between adjacent metal lines is less than the width of the opening.

Chung is discussed on p. 13 above. Chung is, in fact, silent with regard to any thickness of the photoresist pattern. While one object of the invention of Chung is to enhance the etching resistance of a patterned photoresist layer (col. 1, ll. 37-39), Chung also appears to be silent with regard to any defect reduction effects of forming the layer of inorganic material over the patterned and defined photoresist layer. Accordingly, Chung cannot suggest the observed improvements in defect reduction provided by the present method (recited in paragraph 3 of the Lee Declaration, which corresponds to the present Claim 22) as a result of forming a buffer layer on a photoresist pattern. Given the direct relationship between the aspect ratio and the width of an opening in a photoresist pattern as established by paragraph 7 of the Lee Declaration, the deficiencies of Chung are also applicable to an identical method (the present Claim 1) in which the photoresist has a thickness of less than 9000Å and an opening of less than or equal to 0.26 μm width (in terms of the aspect ratio, 9000Å/0.26 μm = 9000Å/2600Å = 3.46).

Therefore, Chung fails to cure the deficiencies of Appellant's Background with regard to forming a photoresist pattern having a thickness of less than 9000 Å and an opening of less than or equal to 0.26 μm width, as recited in independent Claim 1, or having an aspect ratio of less than 3.5, as recited in independent Claim 22. As a result, the claimed invention is fully patentable over Appellant's Background (assuming *arguendo* that it can be used to support a rejection of the present claims) in view of Chung.

Group I

With respect to independent Claim 22, assuming *arguendo* that Appellant's Background can support a rejection thereof, Appellant's Background fails to disclose or suggest forming a photoresist pattern having a thickness of less than 9000Å; forming a buffer layer on the photoresist pattern, including in an opening therein; and selectively removing the metal layer at a lower side of the opening by dry etching to form metal lines such that a dimension between adjacent metal lines is less than the width of the opening. As discussed above, Chung is silent with regard to thicknesses of the photoresist pattern and any defect reduction effects of forming the layer of inorganic material (corresponding to the present buffer layer) over the patterned photoresist layer. Thus, no combination of Appellant's Background and Chung can disclose or suggest the method of Claim 22 or the unexpected results provided thereby.

The Lee Declaration clearly explains the unexpected results provided by the present method. In processes used to manufacture commercial semiconductor devices, to form a plurality of metal lines successfully, gaps between adjacent metal lines are formed without defects that cause a short circuit between the adjacent metal lines (see, e.g., paragraph 5 of the

Lee Declaration; see also step (c) in Claims 1 and 22, which recites "selectively removing the metal layer at a lower side of the opening by dry etching to form a plurality of metal lines").

In processes used to manufacture commercial semiconductor devices in which a critical dimension between adjacent metal lines is 0.26 μm or less, a problem arises when the photoresist has a thickness greater than 9000 Å. In this case, the openings in the photoresist have an aspect ratio (i.e., the ratio of the photoresist thickness to the width of the opening) of greater than about 3.5. In other words, since 9000 Å/2600 Å (0.26 μm) is about 3.5 (using 2 significant digits), a photoresist thickness of > 9000 Å divided by a width of 0.26 μm leads to an aspect ratio of > about 3.5 (see paragraphs 6-7 of the Lee Declaration).

When the openings in the photoresist have an aspect ratio > about 3.5, the aspect ratio of the gap formed between adjacent metal lines having relatively thick photoresist thereon increases. This increase results in an increased likelihood of the formation of metal "stringers" or other defects at the bottom of the gaps between the resulting metal lines that result in a short circuit between adjacent metal lines. In the case where the photoresist has a thickness greater than 9000 Å and the openings in the photoresist have an aspect ratio > about 3.5, the increased likelihood of metal "stringers" or other short circuit-causing defects is unacceptably high for a commercial manufacturing process (see paragraphs 8-9 of the Lee Declaration).

One possible solution to this metal "stringer" problem is to reduce the photoresist thickness to less than 9000 Å. (In a commercial semiconductor manufacturing process, one generally cannot reduce the metal layer thickness without adversely affecting performance of the manufactured semiconductor devices.) However, in many commercial semiconductor manufacturing processes, a thickness of less than 9000 Å for a conventional photoresist may not

be sufficient to dry etch the metal layer under the photoresist (see the last step in claims 1 and 22; also see paragraph 10 of the Lee Declaration).

Typical conditions for dry etching a metal layer in commercial semiconductor manufacturing processes are generally not sufficiently selective with respect to the photoresist to ensure that an adequate amount of photoresist remains over the metal layer to prevent inadvertent etch damage to the top of the metal layer. Thus, when the photoresist thickness is less than 9000 Å in commercial CMOS semiconductor manufacturing processes, there is an increased likelihood of damage to the upper surfaces of the resulting metal lines that can degrade performance of the resulting semiconductor devices and/or adversely affect subsequent processing (e.g., anti-reflective coatings formed at or on the upper surface of the metal lines may have unacceptable anti-reflective properties). In this case, the increased likelihood of dry etch damage to the upper surface of the metal lines is unacceptably high for a commercial semiconductor manufacturing process (see paragraphs 11-12 of the Lee Declaration).

To solve these "metal stringer" and dry etch damage problems, the present method (e.g., as recited in claim 22) first forms a photoresist pattern on the metal layer, where the photoresist has a thickness of less than 9000 Å and a ratio of the photoresist thickness to the width of an opening in the photoresist is less than about 3.5, then forms a buffer layer on the photoresist pattern, including in the opening (see paragraph 13 of the Lee Declaration).

The present method (as exemplified by claim 22) above reduces the likelihood of "metal stringer" (or other short circuit-causing) defects and any adverse effects from dry etch damage to an upper surface of metal lines to levels or values that are acceptable for commercial semiconductor manufacturing processes (see paragraph 14 of the Lee Declaration).

One of ordinary skill in the art of semiconductor manufacturing would not understand or appreciate from reading the Narita and Chung patents (both of which are cited against the present claims) that the present method (e.g., as recited in claim 22) would provide the observed improvements in defect reduction (i.e., ***from commercially unacceptable levels to commercially acceptable levels***; see paragraph 15 of the Lee Declaration; emphasis added).

Chung discloses a semiconductor manufacturing method that includes defining a substrate, depositing a polysilicon layer over the substrate, depositing a layer of photoresist over the polysilicon layer, patterning and defining the photoresist layer, depositing a layer of inorganic material over the patterned and defined photoresist layer where the layer of inorganic material is conformal and photo-insensitive, and anisotropically etching the layer of inorganic material and the layer of semiconductor material (Abstract; see also paragraph 20 of the Lee Declaration).

While it is an object of the invention of Chung to enhance the etching resistance of a patterned photoresist layer (col. 1, ll. 37-39, and col. 4, ll. 23-26), Chung appears to be silent with regard to any defect reduction effects of forming the layer of inorganic material over the patterned and defined photoresist layer. Accordingly, Chung cannot suggest the observed improvements in defect reduction provided by the present method (recited in paragraph 3 of the Lee Declaration and Claim 22) as a result of forming a buffer layer on a photoresist pattern. As a result, the observed improvements in defect reduction provided by the present method (e.g., as recited in paragraph 3 of the Lee Declaration and Claim 22) are unexpected in view of the Chung patent (and the Narita patent cited against Claims 2 and 5-17).

Since Appellant's Background describes only the source of the metal stringer defect and notching problems (i.e., damage to the top of the metal layer due to insufficient photoresist), Appellant's Background cannot lead one of ordinary skill in the art to expect the results provided by the method of Claim 22. As a result, to the extent Appellant's Background can be cited against the present claims, Chung's disclosure does not and cannot cure the deficiencies of Appellant's Background with regard to the same because the results provided by the claimed method are unexpected in view of both Appellant's Background and Chung.

As mentioned above, any teaching or suggestion to make the claimed combination must not be based on Applicant's disclosure. *In re Vaeck*, 947 F.2d 488 (Fed. Cir. 1991). In the Continuation Sheet of the Advisory Action, the Examiner's use of Appellant's disclosure as a guide for reading the claim limitations into the prior art is unmistakably clear:

> "It would have been obvious to one having ordinar(y) skill in the art at the time the invention was made to be able to reduce the photoresist thickness to less than 9,000 angstroms in the conventional process [Appellant's Background] for etching a metal line having a CD of less than 0.23 micron as disclosed in the Background of the invention with the use of buffer layer as suggested by Chang." (Advisory Action, Continuation Sheet, first paragraph)

> "With respect to the Unexpected Results... Chung clearly suggests the use of the buffer layer over the photoresist layer to enhance the etching resistance of the photoresist ***having the lower thickness...***" (Advisory Action, Continuation Sheet, third paragraph; emphasis added)

The Examiner has unmistakably used Appellant's disclosure as a guide to read the present invention into the prior art, even persisting in an unsupported -- and unsupportable -- position that Appellant has admitted that the problems associated with dry etching metal lines having a CD of less than 0.23 micron using a photoresist having a thickness of greater than

9,000Å were well-known and part of the conventional state of the art, when such knowledge has not been established as such using actual prior art (or actual evidence). The Examiner's reading of the invention into the prior art is further betrayed by his assertion -- without evidentiary support -- that Chung suggests the use of a buffer layer to enhance the etching resistance of photoresist ***having a lower thickness***. As mentioned above, Chung is silent with regard to the thickness of the photoresist. In addition, Chung is silent with regard to variations of the photoresist thickness, so Chung cannot possibly suggest anything about a photoresist having a lower thickness.

Consequently, the rejection of Claim 22 (and Claim 20, by virtue of its containing the same limitations as Claim 22) under 35 U.S.C. § 103(a) as being unpatentable over Appellant's Background in view of Chung is unsustainable, and should be reversed.

Group II

Independent Claim 1 and dependent Claims 18 and 21 relate to a method for fabricating a metal line, comprising the steps of:

(a) forming an insulation layer on a semiconductor substrate on which devices or lower lines are formed;

(b) forming a metal layer on the insulation layer;

(c) forming a photoresist pattern ***having an opening of less than or equal to 0.26 μm width on the metal layer***, wherein the photoresist has a thickness of less than 9000 Å (emphasis added);

(d) forming a buffer layer on the photoresist pattern, including in the opening; and

(e) selectively removing the metal layer at a lower side of the opening by dry etching to form a plurality of metal lines such that a dimension between adjacent metal lines is less than the width of said opening.

Assuming *arguendo* that Appellant's Background can support a rejection thereof, Appellant's Background fails to disclose or suggest forming a photoresist pattern having a thickness of less than 9000Å; forming a buffer layer on the photoresist pattern, including in an opening therein; and selectively removing the metal layer at a lower side of the opening by dry etching to form metal lines such that a dimension between adjacent metal lines is less than the width of the opening. Consequently, Appellant's Background necessarily fails to suggest the unexpected results discussed in the Lee Declaration. As discussed above, Chung is silent with regard to thicknesses of the photoresist pattern and any defect reduction effects of forming the layer of inorganic material (corresponding to the present buffer layer) over the patterned photoresist layer. Thus, no combination of Appellant's Background and Chung can disclose or suggest the method of Claim 1 or the unexpected results provided thereby.

The Lee Declaration does not explicitly refer to Claim 1 with regard to the unexpected results discussed therein. However, the relationship between the aspect ratio of the opening in the photoresist and the width of the opening in the photoresist is direct and quite clear, as in paragraph 7 of the Lee Declaration establishes (see also the discussion of "aspect ratio" at the top of p. 16, in the last paragraph of p. 19, and in the first full paragraph on p. 22). In other words, the width of the opening times the aspect ratio equals the height of the photoresist. Therefore,

the unexpected results described in the Lee Declaration for a method that forms a buffer layer on a photoresist pattern on a metal layer, where the photoresist has a thickness of less than 9000 Å and a ratio of the photoresist thickness to the width of an opening in the photoresist is less than about 3.5 (Claim 22) are applicable to a photoresist pattern having a thickness of less than 9000 Å and an opening of less than or equal to 0.26 μm width (Claim 1).

Given the direct relationship between aspect ratio and width of an opening in a photoresist pattern as established by paragraph 7 of the Lee Declaration, the improvements provided by the present method (as exemplified by claim 22) are also applicable to a photoresist pattern having a thickness of less than 9000 Å and an opening of less than or equal to 0.26 μm width (Claim 1).

The failure of Chung to cure the deficiencies of Appellant's Background with regard to the claimed method is discussed in detail in the past paragraph of p. 19 above and throughout the discussion of Group I above. As a result, to the extent Appellant's Background can be cited against the present claims, Chung cannot possibly cure the deficiencies of Appellant's Background with regard to a method including forming a photoresist pattern having a thickness of less than 9000 Å and an opening of less than or equal to 0.26 μm width on a metal layer, forming a buffer layer on the photoresist pattern, including in the opening, and selectively removing the metal layer at a lower side of the opening by dry etching to form metal lines such that a dimension between adjacent metal lines is less than the width of the opening, as recited in Claim 1, or the results provided thereby. Chung alone certainly does not teach or suggest such a method. Therefore, the rejection of Claims 1, 18 and 21 under 35 U.S.C. § 103(a) as being

unpatentable over Appellant's Background in view of Chung is unsustainable and should be reversed.

Group III

Claim 3 depends from Claim 2, and further recites that the buffer layer comprises a particular kind of oxide film. Thus, Claim 3 includes all of the limitations of Claim 2, plus an additional limitation. By the logic in the final Office Action, Appellant's Background in view of Chung does not support a rejection of Claim 3.

Claim 2 (from which Claim 3 depends) has been rejected in view of Appellant's Background, Chung and Narita. Apparently, Narita is necessary to support a rejection of Claim 2. It is not clear how Claim 3, a claim that includes all of the limitations of Claim 2 and a further limitation, can be rejected without reliance on Narita. Thus, by the logic in the final Office Action, no combination of Appellant's Background and Chung can disclose or suggest the method of Claim 3.

Therefore, for this reason plus all of the reasons discussed above with regard to Claim 1 and all of the reasons discussed below with regard to Claim 2 (from which Claim 3 depends), the rejection of Claim 3 under 35 U.S.C. § 103(a) as being unpatentable over Appellant's Background in view of Chung should be reversed.

Group IV

Claim 4 depends from Claim 3, and further recites that the buffer layer has a thickness of 180 to 230Å. Thus, Claim 4 includes all of the limitations of Claims 2 and 3, plus an additional

limitation. By the logic in the final Office Action, Appellant's Background in view of Chung does not support a rejection of Claim 4. Independent from this reason, Appellant's Background is silent with regard to a buffer layer, and Chung fails to disclose or suggest a buffer layer having a thickness of 180 to 230Å. Thus, no combination of Appellant's Background and Chung can disclose or suggest the further limitation of Claim 4.

Claim 2 (from which Claim 4 depends indirectly) has been rejected in view of Appellant's Background, Chung and Narita. Apparently, Narita is necessary to support a rejection of Claim 2. It is not clear how Claim 4, a claim that includes all of the limitations of Claim 2 and two further limitations, can be rejected without reliance on Narita. Thus, by the logic in the final Office Action, no combination of Appellant's Background and Chung can disclose or suggest the method of Claim 4.

Furthermore, both Appellant's Background and Chung are saliently deficient with regard to a buffer layer having a thickness of 180 to 230Å. As discussed above, Appellant's Background is silent with regard to a buffer layer. Chung discloses a number of parameters for deposition of polymer layer 150 (e.g., deposition rate, pressure, feed gases, even a suggestion as to the adjustability of the thickness ratio of polymer layer 150 on top of the photoresist structure 130 relative to the bottom of the opening between photoresist structures 130; see col. 3, ll. 47-65). In one example, Chung teaches that the resulting decrease in spacing between photoresist structures 130 is from 0.22 microns to 0.02 microns (col. 3, ll. 44-46). Thus, if one presumes or infers that the decrease in spacing between photoresist structures 130 is two times the thickness of polymer layer 150, then the thickness of polymer layer 150 = (0.22 - 0.02)/2 = 0.10 microns. Given that 1 micron = 10,000Å (see "The CRC Handbook of Chemistry and Physics," CRC

Press, 64th ed. [1983], Boca Raton, Florida, p. F-317, submitted herewith), then 0.10μm = 1000Å. (To the extent that the "CRC Handbook" evidence is not considered, Appellant's undersigned representative respectfully requests official notice of the fact that 1 micron = 10,000Å.) As a result, Chung does not cure the deficiencies of Appellant's Background with regard to a buffer layer having a thickness of 180 to 230Å.

Thus, no combination of Appellant's Background and Chung can disclose or suggest the further limitation of Claim 4. Therefore, for these reasons and the reasons above with respect to Claims 1 and 3 and the reasons below with respect to Claim 2, the rejection of Claim 4 under 35 U.S.C. § 103(a) as being unpatentable over Appellant's Background in view of Chung should be reversed.

II. THE REJECTION OF CLAIMS 2 AND 5-17 UNDER 35 U.S.C. § 103(a)

The Examiner reversibly erred in rejecting Claims 2 and 5-17, because the cited references (Appellant's Background [to the extent applicable], Chung, and Narita) fail to teach, show, or suggest a method including forming a photoresist pattern having a thickness of less than 9000Å and an opening therein of less than or equal to 0.26 μm width on a metal layer; forming a buffer layer on the photoresist pattern, including in the opening; and selectively removing the metal layer at a lower side of the opening by dry etching to form metal lines such that a dimension between adjacent metal lines is less than the width of the opening (see Claim 1), or the unexpected results provided thereby. This rejection should be reversed.

Claim 2 depends from Claim 1, and recites the further step of forming an organic anti-reflection coating between the metal layer and the photoresist pattern. Thus, Claim 2 includes all

of the limitations of Claim 1, plus an additional step. As a result, the final Office Action rejects Claim 2 in view of Appellant's Background and Chung, in further view of Narita. As will be explained below, Narita fails to cure the deficiencies of Appellant's Background and Chung with regard to Claim 1. By virtue of the patentability of Claim 1, Claims 2 and 5-17 are also patentable over the combination of Appellant's Background, Chung and Narita.

Assuming *arguendo* that Appellant's Background can support a rejection thereof, Appellant's Background fails to disclose or suggest forming a photoresist pattern having a thickness of less than 9000Å; forming a buffer layer on the photoresist pattern, including in an opening therein; and selectively removing the metal layer at a lower side of the opening by dry etching to form metal lines such that a dimension between adjacent metal lines is less than the width of the opening. Consequently, Appellant's Background necessarily fails to suggest the unexpected results discussed in the Lee Declaration. As discussed above, Chung is silent with regard to thicknesses of the photoresist pattern and any defect reduction effects of forming the layer of inorganic material (corresponding to the present buffer layer) over the patterned photoresist layer. Thus, the combination of Appellant's Background and Chung fail disclose or suggest the method of Claim 1 or the unexpected results provided thereby.

As discussed in the Lee Declaration, Narita discloses a dry etching method for use in patterning stacked metal films containing aluminum as the base component and a thin film including at least one of titanium and titanium nitride (Abstract). The method of Narita intends to provide a dry etching method capable of patterning a stacked film such that the thin film is formed vertically, and the metal film is prevented from being side-etched (col. 2, ll. 47-53)

and/or a pattern transfer difference is reduced in the stacked film (col. 3, ll. 1-4 of Narita; see also paragraph 16 of the Lee Declaration).

Narita teaches that the width of processed wiring usually becomes larger than that of a mask when a mask pattern is formed on the stacked film, and then the stacked film is processed by dry etching (col. 10, ll. 18-21). In such a case, it is likely that an interval (or gap) between wiring portions will be narrowed, and a short circuit will be caused easily between them (Narita, col. 10, ll. 21-24). This disclosure is consistent with the discussion in paragraphs 8-9 above regarding the "metal stringer" problem (see paragraph 17 of the Lee Declaration).

Narita further teaches that this problem is difficult to solve in miniaturized devices using conventional approaches (col. 10, ll. 35-36). For example, the wiring cannot be thinned because its resistance is increased, and accordingly, the photoresist mask pattern cannot be reduced in thickness (Narita, col. 10, ll. 36-41). Consequently, Narita teaches that the mask is narrowed and the photoresist mask aspect ratio is increased, resulting in a phenomenon in which the mask pattern is easy to physically fall when it is washed after development (col. 10, ll. 41-45). This disclosure is consistent with the discussion in paragraph 10 above regarding problems resulting from conventional solutions to the "metal stringer" problem (see paragraph 18 of the Lee Declaration).

Narita appears to be silent with regard to forming a buffer layer on a photoresist pattern. Accordingly, Narita cannot suggest the observed improvements in defect reduction provided by the present method (as recited in paragraph 3 of the Lee Declaration and Claim 22) as a result of forming a buffer layer on a photoresist pattern (see paragraph 19 of the Lee Declaration). Given the direct relationship between aspect ratio and width of an opening in a photoresist pattern as

established by paragraph 7 of the Lee Declaration, the deficiencies of Narita are also applicable to an identical method in which the photoresist has a thickness of less than 9000 Å and the photoresist pattern has an opening of less than or equal to 0.26 μm width (see Claim 1 and the discussion thereof above).

Thus, Narita cannot cure the deficiencies of Appellant's Background and Chung with regard to Claim 1 and the unexpected improvements provided thereby. Therefore, the rejection of dependent Claims 2 and 5-17 under 35 U.S.C. § 103(a) as being unpatentable over Appellant's Background and Chung in view of Narita is unsustainable and should be reversed.

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CONCLUSION

Thus, the rejections of the claims in the present application are reversible error, under the provisions of 35 U.S.C. § 103(a). Consequently, the present claims are in condition for allowance.

For the reasons advanced above, Appellant and his undersigned representative respectfully urge that the rejections of Claims 1-18 and 20-22 as being obvious under 35 U.S.C. §103(a) are improper. Reversal of the rejections is respectfully requested.

Respectfully submitted,

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Application No.: 10/728,706

CLAIMS APPENDIX

1. A method for fabricating a metal line of a semiconductor device, comprising the steps of:
   a) forming an insulation layer on a semiconductor substrate on which devices or lower lines are formed;
   b) forming a metal layer on the insulation layer;
   c) forming a photoresist pattern having an opening of less than or equal to 0.26 μm width on the metal layer, wherein said photoresist has a thickness of less than 9000 Å;
   d) forming a buffer layer on the photoresist pattern, including in the opening; and
   e) selectively removing the metal layer at a lower side of the opening by dry etching to form a plurality of metal lines such that a dimension between adjacent metal lines is less than said certain width of said opening.

2. The method of claim 1, further comprising a step of forming an organic anti-reflection coating between the metal layer and the photoresist pattern.

3. The method of claim 2, wherein the buffer layer comprises an oxide film of PE family.

4. The method of claim 3, wherein the buffer layer has a thickness of 180 to 230Å.

5. The method of claim 4, wherein the metal layer comprises a lower metal layer, an intermediate metal layer and an upper metal layer.

6. The method of claim 5, wherein the lower metal layer comprises TiN/Ti.

7. The method of claim 6, wherein the lower metal layer functions as a barrier layer.

8. The method of claim 5, wherein the intermediate metal layer comprises Al-Cu alloy.

9. The method of claim 5, wherein the upper metal layer comprises TiN/Ti.

10. The method of claim 9, wherein the upper metal layer functions as a capping layer.

11. The method of claim 3, wherein the dry etching process is performed by a plasma etching using Cl_2/BCl_3 gases.

12. The method of claim 11, wherein the metal layer comprises a lower metal layer, an intermediate metal layer and an upper metal layer.

13. The method of claim 12, wherein the lower metal layer comprises TiN/Ti.

14. The method of claim 13, wherein the lower metal layer functions as a barrier layer.

15. The method of claim 12, wherein the intermediate metal layer comprises Al-Cu alloy.

16. The method of claim 12, wherein the upper metal layer comprises TiN/Ti.

17. The method of claim 16, wherein the upper metal layer functions as a capping layer.

18. The method of claim 1, wherein said dimension between said adjacent metal lines is less than said certain width of said opening by two times a thickness of said buffer layer at a sidewall of said opening.

19. (Canceled)

20. The method of claim 1, wherein a ratio of said photoresist thickness to said certain width of said opening is less than about 3.5.

21. The method of claim 1, wherein the dimension between adjacent metal lines is less than 0.23 μm.

22. A method for fabricating a metal line of a semiconductor device, comprising the steps of:
    a) forming an insulation layer on a semiconductor substrate on which devices or lower lines are formed;
    b) forming a metal layer on the insulation layer;
    c) forming a photoresist pattern having an opening of a certain width on the metal layer, wherein said photoresist has a thickness of less than 9000 Å and a ratio of said photoresist thickness to said certain width of said opening is less than about 3.5;
    d) forming a buffer layer on the photoresist pattern, including in the opening; and
    e) selectively removing the metal layer at a lower side of the opening by dry etching to form a plurality of metal lines such that a dimension between adjacent metal lines is less than said certain width of said opening.

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Attorney Docket No. PPW06-556DS
Application No.: 10/728,706

EVIDENCE APPENDIX

1. The Declaration under 37 C.F.R. 1.132 of Kang-Hyun Lee, submitted with the Amendment filed on January 12, 2006.

2. "The CRC Handbook of Chemistry and Physics," CRC Press, 64th ed. (1983), Boca Raton, Florida, p. F-317.

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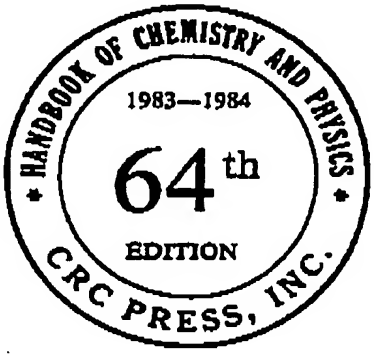
RELATED PROCEEDINGS APPENDIX

Possibly: Application No. 11/024,594 (Attorney Docket No. OPP-GZ-2004-0009-US-00), in which the claims have been rejected in view of Appellant's own disclosure, but where Appellant made no admission that any part of Appellant's own disclosure is, or constitutes, prior art.

CRC Handbook of Chemistry and Physics

A Ready-Reference Book of Chemical and Physical Data



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To convert from	To	Multiply by
Liters/sec.	Cu. yards/min.	0.0784771
"	Gal. (U.S., liq.)/min.	15.850342
"	Gal. (U.S., liq.)/sec.	0.2641721
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"	B.t.u. (IST.)	0.0960417
"	B.t.u. (mean)	0.0959564
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"	Cal., gm. (IST.)	24.2021
"	Cal., gm. (mean)	24.1631
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"	Joules	101.328
"	Joules (Int.)	101.311
"	Kg.-meters	10.3328
"	Kw.-hours	2.81466 × 10⁻⁵
Liter-atm. (lat. 45°)	Joules	101.320
Lumens	Candle power (spher.)	0.079577472
Lumens (at 5550 Å)	Watts	0.0014705882
Lumens/sq. cm.	Lamberts	1
"	Phots	1
Lumens/(sq. cm. × steradian)	Lamberts	3.1415927
Lumens/sq. ft.	Foot-candles	1
"	Foot-lamberts	1
"	Lumens/sq. meter	10.763910
Lumens/(sq. ft. × steradian)	Millilamberts	3.3818832
Lumens/sq. meter	Foot-candles	0.09290304
"	Lumens/sq. ft.	0.09290304
"	Phots	0.0001
Lux	Foot-candles	0.09290304
"	Lumens/sq. meter	1
"	Phots	0.0001
Maxwells	E.M. cgs. units of induction flux	1
"	E.S. cgs. units	3.333333 × 10⁻¹¹
"	Gauss-sq. cm.	1
"	Lines	1
"	Maxwells (Int.)	0.999670
"	Volt-seconds	1 × 10⁻⁸
"	Webers	1 × 10⁻⁸
Maxwells (Int.)	Maxwells	1.000330
Maxwells/sq. cm.	Maxwells/sq. in.	6.4516
"	Maxwells (Int.)/sq. cm.	0.999670
Maxwells (Int.)/sq. cm.	Maxwells/sq. cm.	1.000330
Maxwells/sq. inch	Maxwells/sq. cm.	0.15500031
Megalines	Maxwells	1 × 10⁶
Megmhos/cm.	Abmhos/cm.	0.001
"	Megmhos/inch cube	2.54
"	(Microhm-cm.)⁻¹	1
Megmhos/inch	Megmhos/cm.	0.39370079
"	(Microhm-inches)⁻¹	1
Megohms	Microhms	1 × 10¹²
"	Ohms	1 × 10⁶
"	Statohms	1.112646 × 10⁻⁶
Megohms⁻¹	Mhos	1
Meters	Ångström units	1 × 10¹⁰
"	Centimeters	100
"	Chains (Gunter's)	0.049709695
"	Chains (Ramden's)	0.033656209
"	Fathoms	0.54680665
"	Feet	3.2808399
"	Feet (U.S. Survey)	3.280833
"	Furlongs	0.0049709695
"	Inches	39.370079
"	Kilometers	0.001
"	Links (Gunter's)	4.9709695

To convert from	To	Multiply by
Meters	Links (Ramden's)	3.3656209
"	Megameters	1 × 10⁻⁶
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"	Miles (naut., Int.)	0.00053995680
"	Miles (statute)	0.00062137119
"	Millimeters	1000
"	Millimicrons	1 × 10⁹
"	Mils	39370.079
"	Rods	0.19883878
"	Yards	1.0936133
Meters of Hg (0°C.)	Atmospheres	1.3157895
"	Ft. of H_2O (60°F.)	44.6474
"	In. of Hg (32°F.)	39.370079
"	Kg./sq. cm.	1.36951
"	Pounds/sq. inch	19.3368
Meters/hr.	Feet/hr.	3.2808399
"	Feet/min.	0.054680665
"	Knots (Int.)	0.00053995680
"	Miles (statute)/hr.	0.00062137119
Meters/min.	Cm./sec.	1.666666
"	Feet/min.	3.2808399
"	Feet/sec.	0.054680665
"	Kilometers/hr.	0.06
"	Knots (Int.)	0.032397408
"	Miles (statute)/hr.	0.037282272
Meters/sec.	Feet/min.	196.85039
"	Feet/sec.	3.2808399
"	Kilometers/hr.	3.6
"	Kilometers/min.	0.06
"	Miles (statute)/hr.	2.2369363
Meters/(sec. × sec.)	Kilometers/(hr. × sec.)	3.6
"	Miles/(hr. × sec.)	2.2369363
Meter-candles	Lumens/sq. meter	1
Mhos	Abmhos	1 × 10⁻⁹
"	Cgs. units of conductance	1
"	E.M. cgs. units	1 × 10⁻⁹
"	E.S. cgs. units	8.987584 × 10¹¹
"	Mhos (Int.)	1.000495
"	Mx. (r or nr) units	1
"	Ohms⁻¹	1
"	Siemen's units	1
"	Statmhos	8.987584 × 10¹¹
Mhos (Int.)	Abmhos	9.99505 × 10⁻¹⁰
"	Mhos	0.999505
Mhos/meter	Abmhos/cm.	1 × 10⁻¹¹
"	Mhos (Int.)/meter	1.000495
Mho-ft./circ. mil	Mhos/cm.	0.0133049 × 10⁹
Microfarads	Abfarads	1 × 10⁻¹⁵
"	Farads	1 × 10⁻⁶
"	Statfarads	8.987584 × 10⁵
Micrograms	Grams	1 × 10⁻⁶
"	Milligrams	0.001
Microhenries	Henries	1 × 10⁻⁶
"	Stathenries	1.112646 × 10⁻¹⁵
Microhms	Abohms	1000
"	Megohms	1 × 10⁻¹²
"	Ohms	1 × 10⁻⁶
"	Statohms	1.112646 × 10⁻¹⁸
Microhm-cm.	Abohm-cm.	1000
"	Circ. mil-ohms/ft.	6.0153049
"	Microhm-inches	0.39370079
"	Ohm-cm.	1 × 10⁻⁶
Microhm-inches	Circ. mil-ohms/ft.	15.278875
"	Microhm-cm.	2.54
Micromicrofarads	Farads	1 × 10⁻¹²
Micromicrons	Ångström units	0.01
"	Centimeters	1 × 10⁻¹²
"	Inches	3.9370079 × 10⁻¹¹
"	Meters	1 × 10⁻¹²
"	Microns	1 × 10⁻⁶
Microns	Ångström units	10000